

**Immobilized Metal Polyamine Composites (IMPACS) for Removal and Recovery of Negatively Charged Species from Contaminated Waters and Mine Leaches (University of Montana, Missoula)**

The project is based on an ongoing collaboration between the research group of Professor Edward Rosenberg and the Missoula based company Purity Systems Inc. The overall goals of the collaboration are to develop more efficient methods of recovery of metal mining ore leaches, mine waste drainage and industrial metal processing solutions. To date the collaboration has been quite successful in developing a novel class of solid phase adsorbents that exhibit superior selectivity and sharper separations of multi-component metal solutions encountered in the copper mining industry, stainless steel processing solutions, precious metal solutions and rare earth metal solutions. This success has attracted the attention and investment of a world-renowned mining testing company, Ammtec Ltd. in Western Australia. With the help of Ammtec this technology is currently being commercialized via toll manufacturing. The specific goals of the current grant are to extend the technology to the recovery and remediation of arsenic, selenium and chrome, toxic elements that are pervasive in mine waste and surface water; as well as other technologically important species that are found as negative ions in the mining and metal processing industries. In addition, this grant will investigate process designs that will make manufacturing of these adsorbents in Montana feasible.

**Montana Infrastructure via Science and Technology Enhanced Partnerships – INSTEP [NSF EPSCoR] (University of Montana/Montana State University, Missoula/Bozeman)**

The 2006-2007 MBRCT award will help support several initiatives within the State of Montana NSF EPSCoR project, which is entering its third year of a three-year award period. The Montana NSF EPSCoR program will continue to develop four new research focus areas in: (a) Bioengineering, (b) Biomolecular Structure & Dynamics, (c) Nanotechnology and (d) Neuroscience. Each area builds upon a strong programmatic framework developed in prior EPSCoR initiatives and will be accomplished through faculty hires, graduate and undergraduate student support, technicians, equipment, core support facilities, information technologies, web development and information dissemination, seminars, conferences, and support for visiting scholars at UM, MSU, Montana Tech and the tribal colleges. The overall goal of developing these research focus areas is to amalgamate past, current and future scientists into Centers of Excellence that build and sustain specific expertise in Montana. The EPSCoR project will continue new diversity, K-12, and outreach programs aimed at enhancing the science and technology infrastructure in Montana, including the creation of a Science Learning Center at the University of Montana, building Montana's non-PhD granting institutions' science education capacity, and generating new research space. Montana will assist local businesses through SBIR Phase 0 and 1.5 awards, and new SBIR-based incentives. Overall, the 2004-2007 Montana EPSCoR program is an ensemble of unique partnerships, programs and expertise that will dramatically augment the science and technology infrastructure in the State.

**Evaluation of Oilseed Crops for Biodiesel Production and Quality in Montana (Montana State University, Bozeman)**

Biodiesel will be produced utilizing an oilseed expeller and a research and development biodiesel production system and evaluated for fuel related properties as a replacement for/or blend with petroleum diesel. This project will evaluate and select safflower genetic lines for characteristics that will improve oil yields and enhance oxidative stability for biodiesel, biolubricants and other biobased products and test safflower and other oilseeds for suitability and economic feasibility for biodiesel production. This project will promote the development of biodiesel/biolubricant processing and marketing in Montana to create new jobs, and promote crop diversification. Increased oilseed production will be utilized for energy uses and create new value-added wealth from oilseed crops.

**NeuroSys Innovative Computer Software for Rapid Database Generation (Montana State University, Bozeman)**

This project makes it possible to commercialize revolutionary computer software developed at MSU. NeuroSys, a database development tool, was created to facilitate data sharing in the scientific community. Based on feedback from a wide range of database users it is clear that a multitude of businesses would benefit from the enhanced productivity and reduced costs offered by NeuroSys. This project will explore how a software system, developed in the academic environment for scientific research and collaboration, can simplify the way data is managed, saving significant cost and time. There is significant potential to produce a data management system that can increase productivity and reduce the cost of implementing and maintaining internet accessible databases by up to fifty percent. The potential market for this software is tremendous. The ever growing database management sector yields current annual revenues of nearly \$8 billion. With funding from the Montana Board of Research and Commercialization Technology, this innovative technology can be brought to market and build a substantial computer software company based in the state of Montana.

**Smart Adaptive Antennas for Wireless Communications in Rural and Sparsely Populated Areas (Montana State University, Bozeman)**

This project explores the feasibility of utilizing compact smart antennas in conjunction with a high bandwidth radio system to yield comparable performance for mobile nodes and also to suppress potential interference from unwanted signals. The project will pursue applications of this technology for reliable communications in sparsely populated and remote regions, where range and terrain create challenging obstacles to conventional approaches to wireless networking.

**New Red Laser-Excited Fluorescent Dyes for Ultrasensitive Multiplex Detection in Proteomics and Diagnostics (Montana State University, Bozeman)**

This project will synthesize and test a red laser-excited member of a set of three ultrasensitive proteomic detection dyes that is needed to complete the initial commercial Zdye product package. Blue laser-excited and green laser-excited Zdyes that perform up to expectations have been completed. The Zdye product package out-performs products now in use by 10 to 30 fold in sensitivity, and by a large margin in information content, reliability, and ease of use—resulting in increased cost-effectiveness and speed for drug development, diagnostics, and for applications at academic and commercial research centers world wide. Proteomics is the study of the proteins produced by cells and the

modified forms of these proteins found under different conditions. The Zdyes provide a more powerful tool for pinpointing the proteins and modified proteins involved in health or disease conditions of interest. Once proteins are implicated in a biological process, using the Zdye technology, efforts can be focused on characterization of the protein modifications that control the protein activity, cellular localization and participation in functional protein networks. Combined with existing knowledge, the proteomics results reveal underlying mechanisms, control points for more effective drug development, and illuminate paths for the creation of more specific diagnostic tools.

### **Demineralized Bone Matrix Putty for Transplantation (Bacterin International, Inc., Belgrade)**

Demineralized bone matrix (DBM) is a powdered form of donor derived (allograft) tissue commonly used to repair and replace bone during orthopedic and maxillofacial surgical procedures. Common uses of DBM include the filling of bone voids where bone loss has resulted from trauma, tumor, disease, or fracture, and as a graft extender in procedures such as joint reconstruction or spinal fusion. Recently, attempts have been made to enhance the handling characteristics of DBM by combining it with a binding agent to make it cohesive and malleable. These flexible grafts are commonly referred to as DBM putties. This proposal focuses on the development of DBM putty to be engineered, manufactured, and distributed by Bacterin International, Inc. Emphasis will be placed on producing the best possible handling characteristics for the surgeon while maintaining the highest level of bone formation. This putty will be a natural complement to Bacterin's life enhancing allografts that will be produced in a state-of-the-art tissue processing facility currently under construction in Belgrade, MT. Bacterin believes that its strategies to better promote bone healing via the engineering of a maximally osteoinductive (bone forming) DBM putty can be applied to the care of wounded military personnel, injured civilians, and our aging population.

### **High-Performance Biobased Motor Oils from Vegetable Oil Estolides (Peaks and Prairies, Bigfork/Malta)**

Peaks and Prairies, LLC is in the final stages of formulation and testing on its new biobased motor oil that outperforms current synthetic motor oils. The new motor oil "Eco Oil" is based on Montana grown, high oleic canola oil and is greater than 93% biodegradable. This new biobased oil addresses a number of problems, including: reducing our dependency on foreign oil, providing alternative opportunities for Montana agriculture, reducing emissions, improving fuel economy, providing greater engine protection and eliminating the environmental impact of waste oil disposal. The motor oil, initially focused on the military market, will also quickly find its way to retail store shelves. The company and project are based in Malta and are expected to create numerous new employment opportunities and economic opportunity in Eastern Montana.

### **Research Support for the Development and Manufacturing of a Rapid Biofilm Analysis Test Kit (Montana State University, Bozeman)**

The Center for Biofilm Engineering in collaboration with the Montana company, BioSurface Technologies, Inc., received funding to develop a rapid biofilm analysis test kit. Biofilm consists of bacteria attached to a surface that are embedded in a layer of

slime. Biofilm growth in industrial, medical, and dental water systems is detrimental to system performance and can pose a significant threat to human health. The first step in controlling unwanted biofilm growth is to develop successful monitoring strategies. The current standard for monitoring bacteria is a method known as the viable plate count. Although this method does provide, in most cases, a reliable estimate of viable bacteria, it has some limitations. For instance, correctly performing the viable plate count requires at least a basic knowledge of microbiology and access to a microbiology laboratory, and it may take days or weeks before a researcher knows the result. For the situation where a plant manager is concerned with the bacterial contamination of a product, this wait is too long. The goal of this project is to develop an analysis kit specially designed to measure biofilm activity. The kit will utilize established scientific principals, but the resulting product will be simple enough to be performed by someone with limited microbiology experience and equipment. The kit will detect a variety of bacteria, and the final result will be known in a matter of hours rather than days. Finally, successful development and commercialization of the test kit will strengthen the position of BioSurface Technologies, Inc. as a world leader in the biofilm equipment and supply market.

### **CHRYSATOS Imaging System (AquilaVision, Missoula)**

Through this project AquilaVision, Inc. will create CHRYSATOS, an airborne hyperspectral sensing system that integrates multiple hardware elements, software programs, algorithmic calculations, and processing protocols into a single system that will deliver imagery data that is more precise, more spatially accurate, and more cost effective than any comparably diverse system available commercially. The sensor will be designed to mount in the standard belly-port of a small aircraft, on a rotor craft (helicopter) or on a mid-size unmanned aerial vehicle (UAV). Most objects on the earth's surface reflect light in unique patterns of wavelengths. The visible spectrum – what we see with the naked eye – reveals only a portion of that information. Consequently, different objects, even different species of similar vegetation, can be identified precisely through selective operation of advanced imaging and processing technologies. The CHRYSATOS system will supply agricultural producers with more accurate information for noxious weed detection and control, for crop yield measurements, and for precision agriculture. In forest management, this imagery data can be used for conifer stem density assessments for stocking and thinning operations, and for regeneration. Root rot and mountain pine beetle infestations can be detected at very early stages. Biomass and fuel load assessments can be compiled. In wildlife management, hyperspectral imagery can delineate land cover classifications and habitat quality. CHRYSATOS also has significant potential for deployment within defense and homeland security arenas. The CHRYSATOS sensor system will represent a significant drop in costs for imagery collection, while improving resolution and geospatial accuracy, and streamlining some processing protocols. This combination will position the system for extended use in multiple markets, at the very time where geographic information systems (GIS) and those who utilize GIS within traditional industries (the “geospatial workforce”) are emerging as a major economic force regionally, nationally, and globally.

### **Heat Exchanger Fabrication Technology Development (MSE Technology Applications, Inc., Butte)**

MSE Technology Applications, Inc. (MSE), with headquarters in Butte, Montana, will develop and demonstrate fabrication technology for complex, high-density, cryogenic heat exchangers that are to be used in advanced air-breathing aerospace propulsion concepts. During the Phase II of a U.S. Air Force Small Business Innovation Research (SBIR) project to demonstrate an MSE-patented advanced propulsion cycle, MSE identified significant deficiencies in the national capability to fabricate the complex heat exchangers needed. The heat exchangers are constructed from 1,728 densely packed stainless steel tubes brazed to stainless steel tube sheets. The tubes are 2 millimeters in diameter with paper-thin walls and separated by only approximately 1 millimeter from each other. MSE has identified design and process improvements that will allow these units to be fabricated without the joint failures that have been experienced in the past. During this project, MSE will design and fabricate coupons and small-scale heat exchanger units to demonstrate this fabrication technology. A successful demonstration will enable continued development of advanced aerospace propulsion concepts, and this, in turn, will bring research and manufacturing jobs to Montana.

### **Enhancement of Applied/Translational Research in Biomedicine (University of Montana/COBRE, Missoula)**

The goal of this project is to continue building an applied/translational biomedical research enterprise in the study and treatment of diseases of the nervous system. This effort is intended to leverage the support provided for basic neuroscience research by the NIH Center of Biomedical Research Excellence (COBRE) award ( $\approx$  \$10 million over the next five years) made to the University of Montana's Center for Structural and Functional Neuroscience in a manner that more directly promotes interaction with the private sector and positively impacts the state's economy. Scientists participating include those affiliated with the Center, as well as those in private sector research entities, such as St. Patrick Hospital and Health Sciences Center and emerging Biotech companies in Montana. A strong emphasis is placed on the development of novel diagnostics, devices and/or therapeutic agents related to the treatment of brain injury or disease. The award will be used to support a number of endeavors, including: the development of intellectual property that can eventually be commercialized, the maintenance of high-tech, high-cost shared instrumentations used in research, the training of students, and the continued promotion of collaborative projects between Center researchers and private sector companies in Montana.

### **Development of a Novel, Nanoparticle Vaccine Adjuvant (NanoValent Pharmaceuticals, Inc., Bozeman)**

Vaccines are one of the most highly cost-effective modes of treatment in modern healthcare. It is estimated that vaccination was responsible for over ten years of the total increase in the average human lifespan worldwide during the 20th century, an increase second in impact only to that of clean water. Vaccine research and development are currently gaining increasing support and emphasis for two reasons. First, the fight against bacterial infection is losing ground because of the alarming and inevitable rise of antibiotic resistant strains. Second, it is being realized that vaccines are one of the most economical of all long-term medical interventions. The goal of this project is to explore and optimize the formulation a novel, synthetic polymer nanoparticle (PLNA or

polymerized liposomal nanoparticle adjuvant) as a potent new vaccine delivery vehicle. NanoValent's PLNA technology has the exciting potential to use nanotechnology in the creation of new vaccines to protect humans against pathogenic organisms for which there are no current vaccines available. The proof of principal of this technology will be a demonstration of complete protection against an otherwise lethal challenge of *Yersinia pestis* (the plague) in vaccinated test mice. NanoValent will commercialize the technology by partnering with vaccine companies that specialize in development of new civilian and military vaccine drugs.